PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Ericsson AB
Torshamnsgatan 23
164 80 Stockholm
Sverige

PRH NICOM
2006-06-02
RECEIVED

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	31-05-2006
Applicant's or agent's file reference: P18764W01	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE2004/000192	13-02-2004	

Applicant:
Telefonaktiebolaget LM Ericsson (publ)
et al

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the *PCT Applicant's Guide*.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed invention is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the IPEA: Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Telex 17978 PATOREG-S Telephone No. 08-782 25 00
Authorized officer	

Form PCT/IPEA/416 (January 2004)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
P18764WO1		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SE2004/000192	13-02-2004	
International Patent Classification (IPC) or national classification and IPC		
See Supplemental Box		
Applicant		
Telefonaktiebolaget LM Ericsson (publ) et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 18 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17-08-2005	10-05-2006
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Elisabeth Åselius /LR Telephone No. +46 8 782 25 00

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Cover sheet

International patent classification (IPC)
H04Q 7/38 (2006.01)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/SE2004/000192

Box No. I Basis of the report

1. With regard to the language, this report is based on:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____ ,
which is the language of a translation furnished for the purposes of:

☐ international search (Rules 12.3(a) and 23.1(b))

☐ publication of the international application (Rule 12.4(a))

☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages _____ as originally filed/furnished
pages* 1-12 received by this Authority on 17-08-2005
pages* _____ received by this Authority on _____

☐ the claims:

pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 13 received by this Authority on 24-04-2006
pages* 14-15 received by this Authority on 17-08-2005

☐ the drawings:

pages _____ as originally filed/furnished
pages* 1-3 received by this Authority on 17-08-2005
pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing *(specify)*: _____
☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability: citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims		NO
Inventive step (IS)	Claims	1-20	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention relates to a method for transmitting data packets from a mobile station over two or more radio links to a radio base station. The goal is to eliminate the combiner node, which adds complexity, cost and delays.

In response to a packet being received, the radio base stations report to the mobile station on the quality with which the packet was received. Based on the quality measure the mobile station selects one of the base stations for forwarding the packet further uplink. The mobile station informs on the selected base station in an uplink message, and the selected base station forwards the packet further uplink.

Documents cited in the International Search Report:
D1: US 2003/0142647 A1
D2: EP 1128703 A1
D3: WO 02073988 A2

D1 reveals a method for a cellular mobile communications system comprising at least one mobile station and a plurality of base stations from which an active set of base stations are selected that are capable of providing parallel radio links with the mobile station, (paragraph 0004).

The quality (SIR etc.) of the radio links is first measured by the mobile station and then predicted, (claim 16) and one radio base station ("handoff leg") is selected from the active set of base stations, based on the measurement and predicted result before the packet is transmitted.

The prediction may take place in an MSC or in the mobile station, (0011, 0015), so information on the selected base station is transmitted uplink from the mobile station. …/…

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Box V

Data packets are then forwarded from the selected base station, (=on the selected handoff leg). Only one of the diversity legs may be selected, (claim 16). The mobile station itself may collect the signal measurements and perform the analysis, (0015).

Segmentation of packets and reassembling of segments into packets are disclosed in D2, (0006, 0007, 0067), and D3, (p.14 line 10-p.15 line 25; abstract).

Neither of the cited documents however, reveals a base station selection that is based on measurements of the actual transmission of the packet, where the measurements are sent back to the mobile station, which selects the route for the packet. This also has the further advantage that the user IP protocol layer can be terminated in the base station instead of in a combiner node.

Consequently, the claimed invention fulfils the requirements of novelty, inventive step and industrial applicability.

FAST HARD HANDOVER SCHEME AND MOBILE STATION AND BASE STATION SUPPORTING SUCH SCHEME

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a method in a cellular communications system supporting macro-diversity. It also relates to a mobile terminal and a radio base station for use in such a system.

DESCRIPTION OF RELATED ART

Soft handover is a technique of employing radio links over two or more base stations for communication between a mobile station and the fixed part of a cellular radio network. Soft handover is typically used in DS-CDMA (Direct Sequence Code Division Multiple Access) based cellular systems. In these systems the same radio frequency is used in adjacent cells, which naturally lends itself for exploiting the multiple reception of the mobile stations transmission at adjacent cells for macro diversity.

During soft handover the same radio frame sent by the mobile station MS is received by all base stations involved in the soft handover. In the downlink the same radio frame is sent to the mobile station time synchronized by all base stations. A selection combining point in the network is responsible for selecting one instance of the received radio frame from the ones received by the involved base stations. The group of base stations providing radio links to a specific mobile station is named the active set.

In order for soft handover to provide enough radio capacity gain fast power control is essential. Owing to the fast fluctuating quality on the radio links from a mobile station, which one of the active set base stations that experiences the highest signal power from the mobile station change rapidly. A command to decrease power from any of the base stations will be obeyed by the mobile station whereas it increases its transmit power only if all base stations command power increase. Base stations receiving data from the mobile station when the power is down regulated by another base station, may receive the data corrupted. The combining

node in the fixed part of the network receives data from all base stations of an active set and combines it before it is further transmitted.

WCDMA (Wideband CDMA) is based on DS-CDMA technology and standardised by 3GPP. WCDMA systems employ soft handover to increase radio efficiency by using selection diversity in the uplink and maximum ratio combining in the downlink.

During selection combining in the uplink the base stations involved in the soft handover forward the received radio frames to the selection combining point in the network. The selection combiner performs error checking on the received radio frames and selects the one that has been received error-free. It assembles the higher layer packet and forwards it further up in the network. If the received frames are all corrupted the selection combiner requests retransmission from the mobile station.

WO 02/35779 discloses a Selection Diversity Forwarding (SDF) scheme in the context of ad hoc multihop networks. In cellular mobile systems a central node, such as a Radio Network Controller controls the link and the selection of the base stations. A multihop network works on a completely different basis, leaving to the different nodes of the network to decide on in which direction to forward a received packet. Routing tables are used by the nodes when deciding on the direction. The SDF solution, hence, assumes a transmitter node and several potential receiver nodes that can forward the packet of the transmitter to the destination node. The packet sent by the transmitter is received by all the receivers, which send back quality information about the reception and/or any other information, e.g., path length to the destination, queue information, QoS related information, etc., that can influence the decision on which path the packet should be transmitted. The basic idea is to let the transmitter select which receiver should forward the packet further in the network based on the feedback reports sent by the receivers. Multihop networks do not include features for keeping communication over several parallel radio links. Such missing features are for example regulation of the mobile transmit power from several base stations and a network combining node for diversity combining of packets received over parallel links and/or for re-assembling segments into whole packets.

Soft Handover requires that the retransmission protocol and the segmentation and reassembly function should be located above the selection combining node in the network, that is, user plane radio link protocols can not be terminated in the base station. This complicates network architecture and puts extra load and special quality requirements on the transmission network between the base station and the combining point. When the combining point is located up in the network it also introduces additional delays on the retransmission schedules it is in control of. This may be detrimental for services with hard requirements on delays. By segmentation is meant that higher layer packets are fractioned to fit into radio frames when transmitted on the radio link.

US 2003/0142647 relates to soft handover and has an object of reducing the number of diversity legs. The mobile station selects which base station or base stations, i.e. legs, that are to forward a packet uplink before the packet is transmitted from the mobile station.

US 586 7791 relates to soft handover with a switching centre as a combining node for uplink data. It further discloses that the combining node selects one of the base stations for forwarding an uplink data block, the selection being based upon quality measures sent from the base stations.

SUMMARY OF THE INVENTION

The problem addressed by the present invention is the cost and complications of diversity combining in the network, while also taking into account the need for preserving the diversity gain affect of soft handover as much as possible.

The present invention solves the problem by a method of radio transmitting a packet from a mobile station to two or more base stations while only one of these base station is selected for forwarding the packet further up in the network. The transmitting mobile station selects the forwarding base station. The selection is made after the transmission of the radio packet and it is based on radio link quality measures received from the base stations after the packet transmission.

An advantage of the present invention is that it removes the need for having a diversity combining node in the network, and at the same time it maintains similar diversity gain as in case of soft handover.

The invention allows simplification of network architecture by terminating radio link protocols in the base station instead of in the network combining point. The user IP layer can extend down to the base station. The WCDMA base station can be seen from the IP network point of view simply as an IP node that has a wireless interface similarly to e.g., a WLAN access point. The overall system complexity is also decreased.

As a further advantage the load on the transmission network is decreased, since there is no multiple transmission between the base stations and the combining point as it is the case with existing soft handover solutions.

DESCRIPTION OF THE DRAWINGS

Figure 1 is 3 box diagrams consecutively disclosing the signals sent between a mobile station and base stations according to the steps 1A-1C of an inventive method.

Figure 2 is block diagrams corresponding to those in figure 1 however disclosing the signalling steps 2A-2E of an alternative method.

Figure 3 is a block diagram of a mobile station structure.

DESCRIPTION OF PREFERRED EMBODIMENTS

The principle idea of the present invention is to let the mobile station MS control the uplink selection combining instead of having a combiner node in the network. There is an active set of base stations in relation to each mobile station, any of which can potentially be selected by the mobile station to be the receiver and forwarder of a given packet. The active set can be maintained similarly as in case of soft handover. That is, base stations can be added, removed and replaced in the active set based on averaged measured path loss values.

The mobile station selects for each data packet one of the base stations from the active set that should forward the packet further up in the network. The mobile station can take into account ARQ (Automatic Repeat Requests) feedbacks in the form of positive or negative acknowledgements, link quality reports and higher layer packet segment boundaries when making the base station selection.

The fast hard handover scheme of the present invention is affected by the length of the packets, the packets may be of a length fitting into a radio frame or it may be longer and then needs to be segmented for fitting into two or more radio frames. After transmission the segments need to be reassembled into the original packet at a network node.

The selection of uplink base station

Figure 1 is 3 box diagrams disclosing a mobile station MS and an active set of base station BS1- BS3. The diagrams illustrate the transmissions between the mobile station and the active set base stations BS1-BS3 according to an inventive method. In a first step 1A the mobile station MS transmits a packet that is received by the active set base stations BS1-BS3. The higher protocol layer information packet, e.g. an IP protocol layer, is assumed to fit into one radio frame.

In the second step 1B, two of the base stations BS1, BS3 receive the packet correctly and send positive acknowledgement in response to the mobile stations MS, while one of the base stations BS2 receives the packet corrupted and send negative acknowledgement.

In a next step 1C the mobile station MS selects which of the active set base stations BS1-BS3 shall forward the packet in the fixed part of the network. In the example the first base station BS1 is selected and information on the selected base station is sent to the active set base stations BS1-BS3. The first base station BS1 then forwards the packet while the non-selected base stations BS2, BS3 discard the packet. The information on the selected radio base station BS1 is transmitted from the mobile station MS carried piggy-backed in the next radio frame sent e.g., in the header.

The mobile station MS selects the base station BS1 among the base stations BS1, BS3 that have positively acknowledged receipt of the packet. In the example there are two base stations BS1, BS3 to choose among. The selection of any of the two base stations BS1, BS3 can be random or more parameters can be taken into account for the selection. Should any of the two base stations have sent a command to the mobile station MS to decrease its transmit power, this base station should be selected and the power regulated according to its command. Signal to Interference ratios measured by the base stations BS1-BS3 may also be sent to the mobile station MS and used for the selection of forwarding base station BS1.

The acknowledgements sent from the base stations BS1-BS3 in the second step 1C above, should preferably be sent downlink separately from downlink user traffic, possibly on a dedicated control channel.

The steps 1A-1C described above is repeated for each packet sent from the mobile station MS, however, the base stations that positively acknowledge receipt of the packet may vary among the receiver set as well as the selected base station.

Uplink transmission of segmented data packets

The higher protocol layer data packets may be too large to fit into a radio frame on the radio link. The mobile station MS then needs to segment the packet into two or more segments that each fit into a radio frame. One data packet is then transmitted in two or more subsequent radio frames.

The steps of uplink transmission of a segmented data packet according to the a posteriori selection are illustrated in figure 2.

In an initial step 2A the mobile station MS segments the next upper layer packet into segments fitting into radio frames. In the example an upper layer data packet e.g., an IP packet, is segmented into two radio frames. The mobile station MS sends the first radio frame, which carries the first segment of the upper layer packet. This is received by all base stations BS1-BS3 in the active set. The mobile station MS also maintains a so called receiver set of base stations, which is

always a subset of the active set. The receiver set includes the base stations that have correctly received all segments of the packet so far. This set is initialized to the active set each time when the transmission of a next packet begins. Once a base station is dropped from the receiver set it cannot be reselected into the set until the set is initialized again. That is, the receiver set is a monotonously decreasing set.

During the transmission the base stations BS1-BS3 send back fast power control commands to the mobile station MS. The power control commands are interpreted in the same way as in the original soft handover scheme. However, the mobile station MS accepts power control commands only from the base station that are part of the receiver set. That is, the mobile station MS increases power if all base stations BS1-BS3 in the receiver set instruct for increase and it decreases power if any of the base stations instructs for decrease.

At the next step 2B the base stations BS1-BS3 send back ARQ feedbacks to the mobile station MS. The base stations BS1-BS3 may also send additional link quality reports e.g., signal to interference ratio (SIR). Note that this ARQ feedback should be sent separately from downlink user traffic, possibly on a dedicated control channel. The mobile station MS updates the receiver set according to the received acknowledgements. If all base stations BS1-BS3 within the receiver set have sent a negative acknowledgement the receiver set will not be changed and the mobile station MS will retransmit the packet. If any of the base stations BS1-BS3 have sent a positive acknowledgement, those base stations BS1, BS3 remain in the receiver set, while others that have sent negative acknowledgement are removed from the receiver set. In the current example the first and third base station BS1, BS3 have sent positive acknowledgements and only the second base station BS2 has sent negative acknowledgement, which means that the second base station BS2 will be removed from the receiver set.

In the following step 2C, the mobile station MS sends the next radio frame, which carries the last segment of the upper layer data packet. This radio frame is destined only to the first and third base station BS1, BS3 although the second base station BS2 may also receive the packet. Alternatively it may switch off its

receiver during the data packet transmission but it still needs to receive the control information sent by the mobile station MS.

Next, the first and third base stations BS1, BS3 send ARQ feedbacks to the mobile station MS, see step 2D. In this case only the first base station BS1 has sent positive acknowledgement. The second BS2 may also send acknowledgement but if so this should be ignored since the second base station is no longer part of the receiver set. The mobile station updates the receiver set, which now includes only BS1.

In step 2E that follows, the mobile station MS recognizes that this was the last segment of the upper layer packet. It selects one of the base stations BS1 from the receiver set to be the forwarding node. Note that at this point the receiver set includes those base stations BS1 that have correctly received all segments of the higher layer packet. In this example there is only one such base station BS1, which is the first base station BS1. The mobile station MS signals in the next radio frame which base station has been selected.

In the final step 2F, the first base station BS1 recognizes that it has been selected as the forwarding base station, it assembles the upper layer packet and sends it further up in the network. Other base stations BS2, BS3 that have not been selected discard the data packet.

Segmentation and Reassembly

In the uplink the mobile station MS segments the higher layer packet into radio frames and it continuously maintains which base station BS1-BS3 have received correctly all segments of the higher layer packet so far. As disclosed above the mobile station MS uses the receiver set for this purpose, which is updated based on ARQ feedbacks sent by the base stations BS1-BS3. When the last segment has been transmitted the mobile station MS designates one of the base stations BS1-BS3 from the receiver set to assemble the higher layer packet and to forward it further up in the network.

Alternatively, one of the BSs in the active set can be designated as the reassembling point by the MS. If there are missing segments at the reassembling

BS other BSs can forward them to the reassembling point via the fixed network. The reassembling BS may be changed on a packet-by-packet basis. For instance, the MS may designate the BS for reassembling that has the highest number of correctly received segments.

General remarks to the examples given

For the sake of increased understanding of the principles of the present invention the power commands sent from the active set base stations BS1-BS3 to the mobile station MS has been disclosed as being sent in response to each frame. It should however be noted that a power regulation command is sent with respect to each time slot on the radio link. A radio frame is transmitted over several time slots and accordingly the mobile station MS receives several power commands from each active set base station BS1-BS3 in respect of a transmitted *radio* frame. This does not affect the principles disclosed in the embodiments described.

Downlink transmission

In the downlink all base stations BS1-BS3 within the active set transmit to the mobile station MS and the signals are maximum ratio combined in the mobile station MS. That is, basically there is no change compared to the existing soft handover solution. There should be some splitting node in the network that multicast the user data packets, e.g. the IP packets, to all base stations BS1-BS3 within the active set. The splitting may advantageously be done by a *mobility* anchor point, i.e. typically the uplink selection combining node in use when the present inventions is not applied.

The base stations BS1-BS3s should be synchronized, which can be ensured by some of the synchronization mechanism that is already employed in current cellular systems. The base stations BS1-BS3 segment the upper layer packets and send out the corresponding radio frames to the mobile station time synchronized. The mobile station MS combines the received signals, decodes the packet and based on whether the packet is error free or not it sends back a positive or negative acknowledgement. It needs to be ensured that the acknowledgement sent by the mobile station MS in the uplink can be safely received by all base stations BS1-BS3, even by those that are not part of the receiver set in the uplink. Therefore the acknowledgements have to be sent either on a separate control channel or they need to be better protected by coding etc., if they are sent piggy-backed on uplink user data.

If the acknowledgement sent by the mobile station MS in the uplink is interpreted differently by the base stations BS1-BS3 due to errors occurring independently on the radio links to the different base stations BS1-BS3, the downlink transmission of the base stations BS1-BS3 at the next radio frame will end up in a complete interference. Some base stations BS1-BS3 that have perceived a positive acknowledge will transmit the next radio frame, while others that have perceived a negative acknowledgement will retransmit the current frame. This results in a total interference of signals, which cannot be handled by the RAKE receiver in the mobile station. This situation should be avoided by appropriate protection of ARQ information. However, such a situation can not be precluded. If it happens, the mobile station MS will not be able to decode the downlink transmission, therefore it will keep sending negative acknowledgements in the uplink, which sooner or later will be correctly received by all base stations BS1-BS3. At this point all base stations BS1-BS3 will retransmit the packet and the packet level synchronization of downlink transmission will be restored.

Alternatively, downlink soft handover could be omitted. In this case the downlink base station could be the same as the uplink base station and only the selected base station transmits and receives to/from the mobile station MS. The uplink and downlink base station could alternatively be two different, in which case the mobile station MS could select from which base station it wants to receive the next downlink packet.

Mobile Station

Fig. 3 is a block diagram of the components essential for a mobile station MS modified for enabling the method of the present invention. For carrying out the method the mobile station MS also needs further structures, however, since they are common for mobile stations in general these structures has been left out for the sake of increased understanding of specifics of the invention.

At a transmitter side 50-54, 59 of the mobile station MS, a segmentation unit 50 receives incoming upper layer packets. The packets are first segmented, if being too long to fit into a radio frame, and put into a transmit buffer 51. The packet segments are scheduled for transmission on the radio frames. Before being sent by radio transmitter 54, the packet or segments passes header generator 53 and a header is added. Also, one copy of the segment is put into a retransmit buffer 52 for possible future retransmission.

In response to the uplink transmissions, the mobile station MS gets quality information from the base stations BS1-BS3. Radio receiver 55 receives the information for further processing at receiver side 55-58, 501.

Specifically, ARQ feedback information, i.e. acknowledgements, are forwarded from the radio receiver 55 to a transmitter side ARQ entity 57. Based on the ARQ feedback, some of the earlier segments may need to be retransmitted, which is controlled by the ARQ transmitter entity 57. Segments that are correctly received by a selected base station can be deleted from the retransmit buffer.

The selection of the base station is done in the quality info processor 56, which has an input from receiver 55 for receiving quality information, that preferably include the ARQ feedback information and transmit power commands and possibly signal to interference ratios reported by the base stations BS1-BS3. Quality info processing involves prediction of the best base station in case of a priori selection of base station.

The quality info processor 56 has an output to the header generator 53 for informing on the selected base station. Information on the selected base station is included in a header of at least one segment of the packet to be transmitted whether the selection is relevant for the packet being transmitted i.e. in the a priori selection case or be it relevant for a previously transmitted packet, i.e. the a posteriori selection.

The quality info processor 56 has a second output to a power control entity 502 that sets the transmit power. The power control is based on commands received from the one selected base station or from the receiver set base stations. Downlink streams of packet segments are received by radio receiver 55 and put into receiver buffer 58. ARQ at receiver Unit 59 has an input from the receiver buffer 58 and based on the reception state of the segments, an ARQ feedback is generated. Segments that have arrived correctly are forwarded to reassembly unit 501 and reassembled into packets.

CLAIMS

1. A method for a cellular mobile communications system comprising at least one mobile station (MS) and a plurality of base stations from which an active set of base stations (BS1-BS3) are selected that are capable of providing parallel radio links with the mobile station (MS), comprising the steps of,

transmitting a packet uplink from the mobile station (MS),

transmitting from the base stations of the active set to the mobile station MS measures of the quality on the radio uplinks made during receipt of said packet , c h a r a c t e r i s e d by the further steps of;

selecting one radio base station (BS1-BS3) from the active set of base stations (BS1-BS3) based upon said quality measures;

transmitting information on the selected base station (BS1-BS3) uplink from the mobile station; and,

forwarding the data packet on a fixed link from the selected radio base station.

2. The method according to claim 1 wherein all the active set base stations (BS1-BS3) provide parallel radio downlinks to the mobile station (MS).

3. The method of claim 1 wherein the measures of the radio uplink quality is/are acknowledgement(s) sent in response from one or more of the active set radio base stations upon said packet being received.

4. The method of claim 1 wherein the measures of the radio uplink quality are transmit power commands.

5. The method of claim 1 wherein the measures of the radio link quality are signal to interference ratios.

6. The method according to claim 1 wherein said packet is segmented into two or more segments for transmission in subsequent radio frames and the selected base station (BS1-BS3) reassembles the segments into said packet.

6. The method according to claim 1 wherein said packet is segmented into two or more segments for transmission in subsequent radio frames and the selected base station (BS1-BS3) reassembles the segments into said packet.

7. The method of claim 3 and claim 6 as dependant on the selection after transmission alternative of claim 1, wherein one or more base stations that has positively acknowledged all previously transmitted segment(s) of said packet are the only designated for reception of subsequent segments of said packet.

8. A mobile station (MS) for use in a cellular communications system and comprising,

means (54) for transmitting a packet to be received by two or more base stations (BS1-BS3),

means (55) for receiving measures of radio link quality experienced by said base stations during the data packet transmission, c h a r a c t e r i s e d by:

a posteriori selecting means (56) for selecting based upon said measures one of said base stations after said packet has been transmitted from the mobile station; and,

means (53, 54) for transmitting uplink information on which of the active set base stations that is selected, for the packet to be forwarded on a fixed link by the selected base station.

9. The mobile station (MS) of claim 8, having means for receiving packets transmitted from two or more radio base stations in parallel and combining the packets.

10. The mobile station of claim 9 wherein said combining is maximum ratio combining.

11. The mobile station of claim 8 wherein said measures of radio link quality is/are one or more acknowledgement(s) on the receipt of the transmitted packet(s).

12. The mobile station of claim 8 wherein said measures of radio link quality are transmit power commands received from said base stations.

13. The mobile station of claim 8 wherein said measures of radio link quality are signal to interference ratios.

14. The mobile station of claim 8 having means for segmenting the packet into segments fitting into radio blocks.

15. The mobile station of claim 14 wherein the mobile station power control is controlled by power command(s) received only from one or more of said base station(s) that have reported positive acknowledgement(s) with respect to the transmitted segment(s) of the relevant packet.

16. The mobile station of claim 8, wherein the uplink information transmitting means is arranged for transmitting the information on said selected base station piggy-backed on the next radio frame.

17. A base station (BS1-BS3) having means to radio receive a packet from a mobile station and means to send an acknowledgement to the mobile station in response to the received packet, c h a r a c t e r i s e d by ,

detecting means for detecting information from the mobile station on a specific base station being selected for forwarding uplink a previously received packet;

means for selectively forwarding the received packet further in a connected radio network when said detecting means detects the base station is being selected.

18. The base station of claim 17 the detection means is adapted for receiving the selection information on a packet-by-packet basis.

19. The base station of claim 17 or 18 having means for timing downlink transmission of radio frames by use of a synchronisation signal received via an interface to a fixed part of the network for parallel transmission of radio frames from all base stations of an active set.

20. The base station of claim 18 said detection means arranged for detecting the selection information when it is piggy-backed on the received packets.

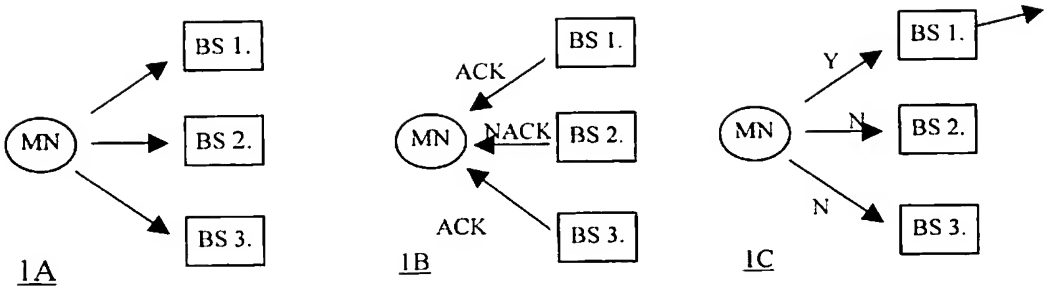

Fig. 1

Amended sheet

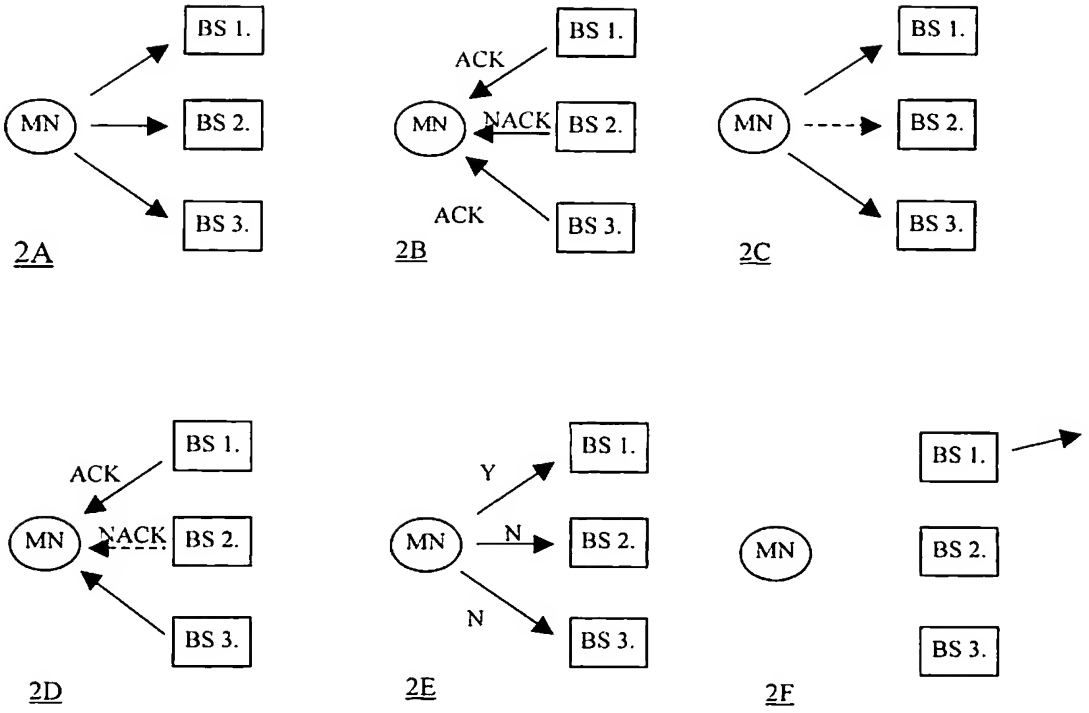

Fig. 2

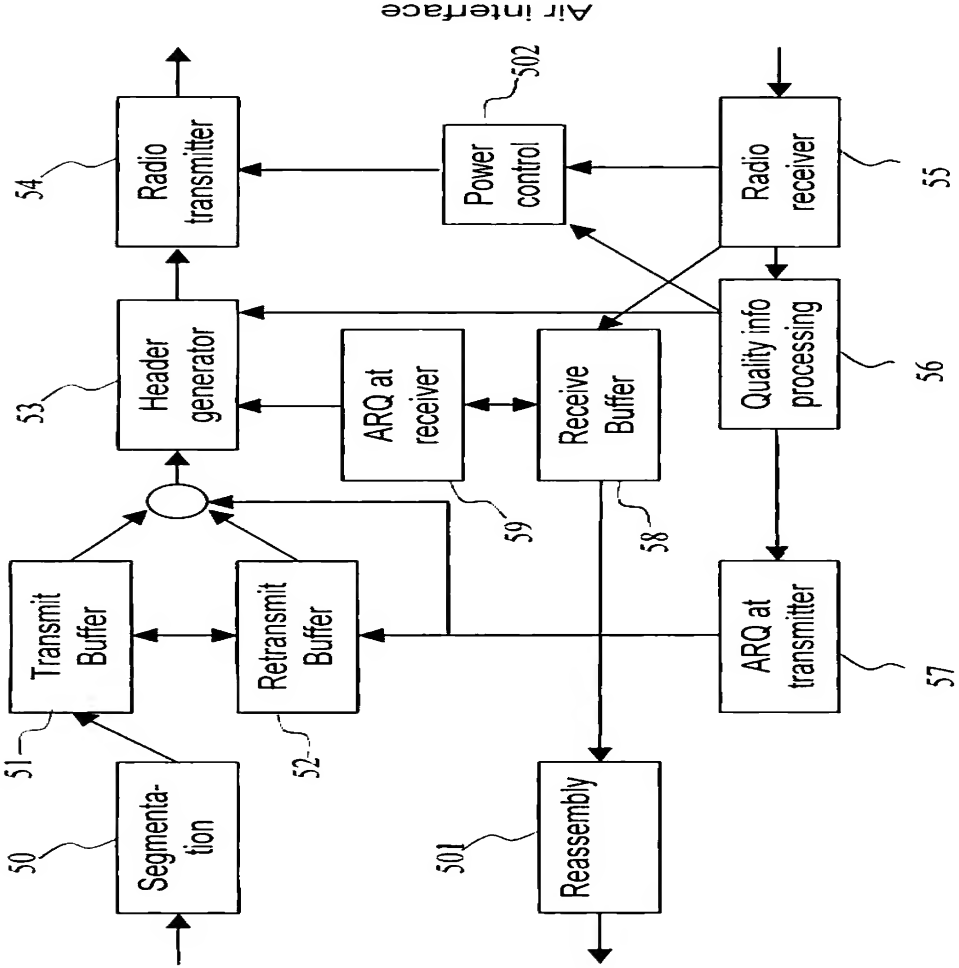
Air interface
Radio transmitter
Power control
Radio receiver
Header generator
ARQ at receiver
Receive Buffer
Quality info processing
Transmit Buffer
Retransmit Buffer
ARQ at transmitter
Segmenta-tion
Reassembly
50
51
52
53
54
55
56
57
58
59
501
502

Fig. 3